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**CONSERVATION, SHARKS, AND THE TRAGEDY OF THE COMMONS:
ACHIEVING HUMAN-NATURE HOLISM**

**A thesis submitted to
Regis College
The Honors Program
in partial fulfillment of the requirements
for Graduation with Honors**

by

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May 2021

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Abstract

Environmental ethics is based on the idea that the relationship between humans and non-human nature ought to be considered morally. How we deal with environmental issues depends on our perception of human-environment relationships. Many view nature as something separate from themselves to own, use, and exploit for human benefit; others view nature as something of which humans are a part and having an intrinsic value aside from practicality or usefulness. This thesis examines human-environment relationships through the perspectives of anthropocentrism and ecocentrism and advocates for balancing the two perspectives. Furthermore, this thesis examines the importance of marine environmental conservation, particularly shark conservation, and how transitioning towards human-environment balanced policy & management decisions in this field can help us to ameliorate the Tragedy of the Commons and increase support for shark conservation. In doing so, this thesis looks at common property resource systems, the High Seas, and shark conservation, including our interactions with shark fisheries, finning, and marine ecotourism to convince the average person that humans are not separate from nature, and nature does not exist solely to benefit us. Additionally, we are interconnected with the natural world; we depend on each other much as science, ethics, and economics do, and it is important to recognize this when we interact with nature. A balance between ecocentrism and anthropocentrism is required to understand the inherent value of nature, helping us to achieve more sustainable practices in fishing and ecotourism, to mitigate the Tragedy of the Commons, and to abolish the human-nature dichotomy through the appreciation of a land-and-sea ethic.

Introduction

“Far and away, the greatest threat to the ocean, and thus to ourselves, is ignorance. But we can do something about that.” – Sylvia Earle

Despite growing up in a land-locked state, I’ve always felt a strong connection to and love for the ocean; just as the moon’s gravity attracts the tides, the ocean’s gravity attracts me. I love the way water flows around the world—from rivers to seas—carrying sand, algae, plankton, fish, and more to different communities and lands. I love the fact that a whale, dolphin, or shark can travel from one sea to another—nomadic—yet still have somewhere beneath the waves to call home. I love that there are so many different types of fish and other creatures to see on a snorkeling trip.

I was 8 years old when I first visited a beach, built a sandcastle, played in the waves, saw rocks covered with black California Mussels (*Mytilus californianus*), and held a clam that I found by my feet. I remember being fascinated with the cool softness of the waves lapping at the shore and the strength at which they tumbled unsuspecting swimmers in the surf. I was in love with the fact that there was a giant salty pool out there that held much more life than I could see in a day, and I couldn’t wait to experience more. Each successive visit to Harbor Beach in Oceanside, California intensified my curiosity and love for the salty, watery realms I’d grown up without. I began googling “marine biology” and asking any adult I could find about the ocean and its creatures. I watched nature documentaries

with my dad when I wasn't doing homework, and read library books about sharks and octopods.

I soon became enveloped by the lore and literature of the sea and fell in love with Finding Nemo, Jules Verne, and sharks. From elementary to high school, I collected seashells where I could find them, marine-related stuffed animals (including an orca, jellyfish, and octopus), books, posters, and most importantly, knowledge. I even have a shark-themed deck of playing cards with interesting facts about a variety of shark species.

By my senior year of high school, I was dead set on applying to marine biology programs for my undergraduate degree, destined to become a marine biologist. What I didn't realize at the time was that I didn't need a "Marine Biology Degree" to be considered a "Marine Biologist," and I didn't realize that I would end up going to a local, Jesuit university in Denver, Colorado to obtain a bachelor's degree in Biology. This evolved into Biology with an emphasis in Ecology and Evolution and a minor in Environmental Studies, but it was not where I expected to end up.

At Regis University, I have been able to further expand my biological interests and find more connections and future paths that are meaningful to me than I might have found elsewhere. Now, I am still in love with sharks, rays, and octopods, but instead of wanting a research-based degree in marine biology to become a "Marine Biologist," I want to be a marine conservationist and work with policy, environmental justice, ethics, marine protection and restoration, fisheries management, climate, and perhaps more. My hope for this thesis is that those who read it will learn more about the myriad aspects of shark conservation, marine environmental ethics, and how to respect nature and recognize its

value while reflecting on human-nature interactions and feeling the same excitement and curiosity about the ocean as I do.

About 70 percent of this planet is covered by the ocean, which contains up to 99 percent of the available living space and an estimated 50 to 80 percent of all life on Earth (UNESCO 2014). Without the ocean, without water, there would be little-to-no life on this planet. Our cosmic oasis of blue and green would instead look desolate and empty like our neighbor Mars. Many people take this fact for granted and forget that without the blue, there can be no green. We are indebted to the ocean for she has given us life and it is time that we come together to protect her as best we can, lest we reach a breaking point of disrespect and destruction from which there is no coming back.

Not only must we protect the ocean as a whole, we must also respect and protect the creatures that live in the ocean, and the different types of marine ecosystems in which they are found. For example, sharks and rays provide numerous ecosystem services in each of their different marine habitats, and they help to balance the overall oceanic system. In a paper on coastal northwest Atlantic ecosystems by Myers et al. (2007), researchers found that populations of apex predatory shark species (those that consume small sharks, skates, and rays) in those areas had fallen over the past 35 years prior to the study, causing a restructuring of the community towards an overabundance of Cownose Rays (*Rhinoptera bonasus*). This abundance of Cownose Rays had led to enhanced predation on Bay Scallops (*Argopectan irradians*), decimating a century-long scallop fishery in the area of the study (Myers et al. 2007). Imbalances such as this one have happened elsewhere around the

world's oceans, as well as other catastrophic imbalances due to lack of respect, protection, research, or awareness for human-ocean interactions and how marine life can benefit us.

Due to the sensationalist media reports on shark attacks or sightings, as well as the misunderstood and exaggerated representations witnessed in books and movies such as *Jaws*, one may ask, “Why should I care about protecting or conserving sharks? Aren’t they fearsome predators? They attack people.” But placing the majority of shark species into the stereotype of being frighteningly savage creatures that attack humans unprovoked is disrespectful to the variety of wonderful elasmobranchs (sharks, skates, and rays) that have evolved over thousands of years, not to mention wrong and uneducated. Sharks deserve protection and respect too, as contrary to popular belief, not all sharks are fearsome apex predators who swim around eating whatever they can find. There are over 1,000 species of elasmobranchs and while there are plenty of large predatory sharks such as the Tiger Shark (*Galeocerdo cuvier*), Scalloped Hammerhead Shark (*Sphyrna lewini*), or the Great White Shark (*Carcharodon carcharias*), there are plenty of sharks that are harmless to humans. Some examples of docile shark species include the Caribbean Nurse Shark (*Ginglymostoma cirratum*), Whale Shark (*Rhincodon typus*), Basking Shark (*Cetorhinus maximus*), Bamboo Sharks (*Chiloscyllium* spp.), and the three-foot-long Epaulette Shark (*Hemiscyllium ocellatum*) that walks along sandy bottoms by wiggling its body and pushing forward with its pectoral fins. Furthermore, the predatory shark species that many people do fear are not as harmful to us humans as we are to them, and the statistical likelihood of a dangerous encounter or death by an attack is very low compared to the likelihood of death by cancer, heart disease, or even accidental drowning (Fig. 1).

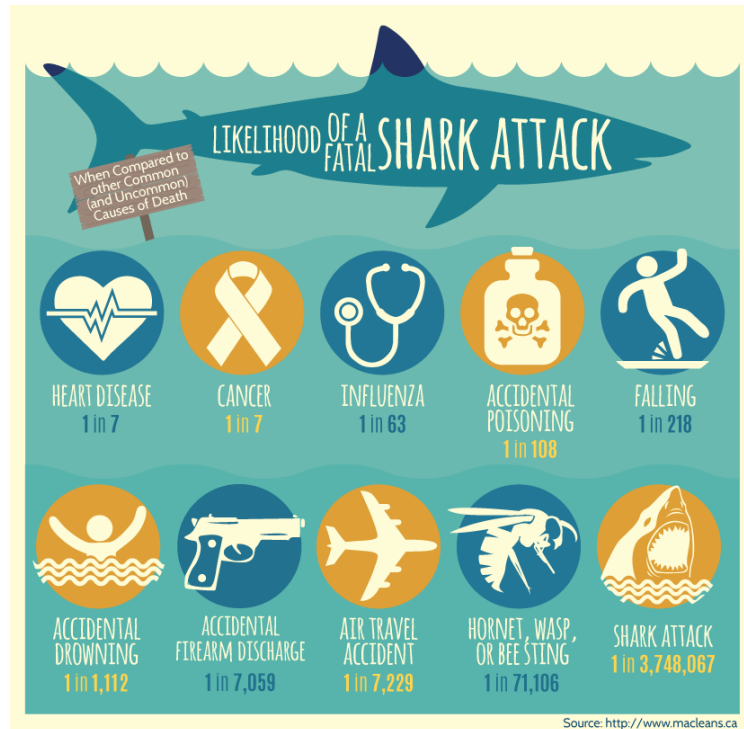


Figure 1. Likelihood of a fatal shark attack compared to other potential causes of death, both common and uncommon. (Source: <http://www.macleans.ca>).

Despite their strong jaws and sharp teeth, sharks like Great White Sharks and Hammerhead Sharks need to be respected, rather than unnecessarily feared. While they do have the potential to harm humans, most sharks will not attack a human unless they are provoked, feel physically threatened, or mistake a person for a prey item. They are also much more vulnerable to anthropogenic influences than many people realize due to their slow growth, long reproductive cycles, and ability to be easily caught in fishing nets or on longline hooks. Because they are so vulnerable, misunderstood, and thus feared, many people don't care about sharks enough to consider protecting them. I also believe that another reason why shark conservation can be difficult to gather support for is the fact that we live in an anthropocentric society where our economy and respect for nature are largely

based on whether or not natural resources, ecosystems, or organisms will directly benefit us. Instead, I think that this can be combatted by shifting towards a more holistically balanced society in which all aspects of non-human nature are respected as they are part of ecosystems that bring balance to the world, and have more intrinsic value than that which is purely economic or aesthetic. Furthermore, to continue towards a society balanced through a sense of human-nature holism and gather support for shark and general marine conservation, we need to discover ways to combat the Tragedy of the Commons that occurs in our oceans and prevent further collapse of vulnerable marine ecosystems and their resources.

Chapter 1: Ecological Moral Dilemmas

“We won’t have a society if we destroy the environment.” – Margaret Mead

The Origins of Environmental Ethics

Environmental ethics is based on the idea that the relationship between humans and nature ought to be considered morally, which automatically causes a dichotomy between humans and non-human nature. This field of philosophy, which emerged during the early 1960s, has roots in prominent authors and environmentalists such as Aldo Leopold, Sierra Club founder John Muir, theologian Albert Schweitzer, and Rachel Carson, author of “Silent Spring” (Kortenkamp & Moore 2001). During this time, environmentalists began to urge philosophers to consider moral and philosophical characteristics of environmental issues and to incorporate nature and sustainability into the boundaries of ethical thinking.

How we deal with environmental issues tends to depend on our perceptions of human-environment relationships. Many view nature as something separate from themselves to own, use, and exploit for human benefit; whereas others view nature as something of which humans are a part of and having an intrinsic value aside from practicality, usefulness, economic benefit, or aesthetic beauty. As such, there are multiple different ways to extend moral consideration to non-human nature, either individually—extending intrinsic moral value to individual organisms—or holistically—extending value to entire species, communities, or whole ecosystems (Kortenkamp & Moore 2001). This is

dependent on a responsibility-based versus a rights-based extension of morality; i.e., do humans have a responsibility to protect nature, or does nature itself have the right to be protected regardless of our responsibility to do so? Specifically, “nature” here shall be defined as the “phenomena of the physical world collectively,” especially “plants, animals and other features and products of the earth itself... including human beings” (Oxford English Dictionary, n.d.). This definition of nature is a more holistic definition that considers humans as well as non-human organisms and aims to abolish the human vs. non-human nature dichotomy, which is inherently anthropocentric in perspective.

The term “anthropocentric” was initially developed in response to Charles Darwin’s theory of evolution, identifying human beings as the most important life form on earth such that other life forms are only important if they can affect humans (Kortenkamp & Moore 2001). This term sets the stage for how many people today view the environment and our relationship to nature. In direct contrast to anthropocentrism is ecocentrism. The term “ecocentric” originated from “biocentric,” a term which now corresponds to a separate ethical viewpoint called “biocentrism” and has a meaning separate from “ecocentrism.” “Biocentric” originally meant that life originates from the universe; therefore, all life is at the center of moral consideration in the universe, not only humans but including humans and is the basis for the theory of ecocentrism (Kortenkamp & Moore 2001). In ecocentrism, moral consideration is awarded to organisms as part of an ecosystem or community, as well as their ecosystems as a whole. Other ethical theories include biocentrism, which focuses on awarding moral consideration to individual organisms in-and-of themselves, and deep ecology, which refers to the level of questioning, down to the elemental root causes of

environmental issues (Naess 1972). Furthermore, deep ecology argues that the inherent value of all things must be incorporated into environmental policies.

Anthropocentrism

The moral dividing line between humans and nature is a socially constructed ethic. A human-nature dualism and anthropocentric ideals have long been present in a range of cultural and philosophical perspectives and continue to be represented in the current systems of corporate environmentalism and our environmental management paradigm (Purser, Park & Montuori 1995). Anthropocentric ideas bloomed during the Enlightenment Period (1715 – 1789) with the materialistic and mechanistic worldview of that time and the fact that the environment was considered to be under the domain of natural laws and could be understood through observation (Purser, Park & Montuori 1995). This led to a camera-like focus on—but detachment from—the non-human natural world, with human beings treated as external observers rather than involved participants.

Although inherently selfish, this human-focused worldview does have some positive aspects that have helped to propel science and awareness for the natural world around us and should still be considered when analyzing our relationship with the environment. Anthropocentric environmentalism can be associated with aesthetic ideals, which can inspire people to look at the various aspects of non-human nature around them and see that the environment can be aesthetically valued. Although aesthetic ideals are most often for our pleasure, they can help garner support for environmental protection and restoration, but should not be the primary reasoning behind such acts. The human-nature dualism has also allowed us to gain the ability to know nature via the scientific method, as

well as manage nature to conserve and preserve it. Observing, conserving, and preserving non-human nature are not inherently anthropocentric acts, but can be done primarily for human benefit rather than environmental benefit, which would make them unequally focused. Instead of conserving and preserving nature primarily for human benefit, doing it chiefly for the ecosystem must be considered as well.

On the other hand, anthropocentrism has inhibited the growth of environmental ideals that are not based on human benefit. For example, some preservationist ideals, such as aesthetics, may fail to teach people to respect nature in-and-of-itself or as part of a system by simply placing an aesthetic or economic value on it, as opposed to moral values. Human-nature dualism creates a “nature-as-object” view (Purser, Park, & Montuori 1995), and these social constructs continue to shape relationships to and perspectives of non-human nature such that nature becomes a thing for humans to control, conquer, and exploit. Anthropocentric nature management (for human benefit) can also take away from the opportunity to restore, conserve, preserve, and protect non-human nature primarily for the benefit of the surrounding environment and the earth overall. While garnering support for certain aspects of conservation or habitat restoration may require justification in terms of how it benefits humans, there should be a sense of human-nature holism—a balance between anthropocentrism and ecocentrism—such that humans are not only the primary reason for conserving an ecosystem, especially when considering nature management. Without this balance of focus between human and non-human nature in environmental management, nature may continue to be seen primarily as a means to an end for human health and advancement in science. Environmental conservation for human health and

scientific advancement is not inherently inappropriate or “bad,” but when in contact with non-human nature, should equally consider how the rest of the ecosystem fares.

Anthropocentrism is missing many important aspects that factor into our relationships with nature, particularly the fact that in a biological and ecological sense, human beings are related to and must be a part of nature. We are living beings, just as the plants, microbes, fish, and other mammals on this earth are. Anthropocentrism also fails to consider that nature has properties that exist independently of human beings. For example, not all nature has an aesthetic or economic value directly relating to humans (Leopold 1949). One aspect of an ecosystem will affect others, but we may not see the importance of those aspects or effects during initial observations. Take a bog, for example; not everyone wants to spend a nature retreat in a damp wetland full of peat moss and squishy mud instead of being surrounded by a crystal-clear mountain lake and towering lodgepole pines, which may be more aesthetically pleasing. But that doesn’t mean that we should not care for or respect the bog, which provides habitat and resources for other creatures and organisms, which in turn provide ecosystem services for each other and help keep the health of the community in check. Anthropocentric environmentalism may be the go-to perspective for many people today when it comes to evaluating our relationship with non-human nature, but that doesn’t mean that it should be. On the contrary, people need to consider balancing environmentally-focused views with anthropocentrism or switching to a more holistic, open view that is less focused on how the environment can benefit us. This perspective is ecocentrism.

Ecocentrism

Specifically, because not every aspect of nature is aesthetically or economically valuable to the human race, we need to shift towards human-nature perspectives that are either primarily focused on the inherent value of natural environments, ecosystems, and the organisms within them, or we need to balance the two perspectives. This balance can be achieved by considering environmental management that is chiefly ecosystem-focused and that which is human-focused with equal weight, breaking down the human-nature dualism that is so common today.

Potential nature-focused perspectives to adopt rather than anthropocentrism include ecocentrism, biocentrism, and deep ecology. Although ecocentrism has origins in biocentrism, they are different perspectives as current biocentric theory awards moral consideration and value to individual organisms in-and-of themselves, rather than whole ecosystems or individuals as part of an ecosystem, as ecocentrism does. When comparing these two moral theories, ecocentrism is a more holistic view than biocentrism as biocentrism does not consider the fact that living organisms are essential to their ecosystems and the planet. Biocentrism ascribes moral consideration to individual organisms primarily because they are alive, not including their importance to the rest of the world. Ecocentrism considers the whole system and the interconnectedness that each organism has with the others in the ecosystem, including human beings.

Environmental crises are continuing, making it obvious that man's utopias and moral visions are "little more than empty enterprise when they depart too far from nature's ways" (Worster cited in Devall 1980, 308). We need to reanalyze our perspective of nature

and our relationship to prevent further dichotomization and departure from “nature’s ways” through the adoption of an ecocentric worldview. Another way to reanalyze and break down the human-nature dichotomy is through deep ecology: an environmental ethical theory expanding upon ecocentrism developed by the Norwegian philosopher and mountain climber Arne Naess in 1972. In Naess’s original article, deep ecology is described as the “rejection of the [human-nature] image in favour of *the relational, total-field image*” (1972, 95) such that it “first attempts to question and present alternatives to conventional ways of thinking” about the environment (Devall 1980, 303). Deep ecology considers the fundamentals of environmental issues and finding value in nature, it questions our perspectives on nature, rejects the human-nature dichotomy, and embraces the whole of nature. Deep ecology is not just a short term, pragmatic environmental movement, it is a long-range movement used as a lens for observing and interacting with the world, much like ecocentrism in general (Devall 1980, Naess 1972).

Renowned environmentalist, Aldo Leopold, clearly describes the need for an ecocentric perspective over an anthropocentric or biocentric perspective in his essay “The Land Ethic” by stating that “there is as yet no ethic dealing with man’s relation to the land and to the animals and plants which grow upon it” (1947, 238). Here an ethic is described as a manner of guidance when interacting with the environment (Leopold 1949) and this quote implies that the human race does not have a specific set of moral guidelines to ascribe towards the connections between humans and non-human nature. In his essay, Leopold (1947) further emphasized the following:

The land ethic simply enlarges the boundaries of the community to include the soils,

waters, plants, and animals, or collectively: the land... A land ethic of course cannot prevent the alteration, management, and use of these ‘resources,’ but it does affirm their right to continued existence... In short, a land ethic changes the role of *Homo sapiens* from conqueror of the land-community to plain member and citizen of it. It implies respect for his fellow members and also respect for the community as such. (239-240)

This land ethic, a moral guideline for environmental interaction, includes all aspects of an ecosystem or community, including the human beings associated with that system. Having a manner of guidance by which we should interact with non-human nature such that the rest of the natural world is respected creates more holistic ecological management and relationships with the surrounding plants, animals, and other organisms in our environments. Once we embrace a land ethic or an ecocentric perspective through which we interact with all of nature, we will more clearly see our relationship and interconnectedness with nature, as human beings are a part of the natural world, or “citizens” as Aldo Leopold put it.

While Leopold’s essay is brilliantly articulated, his land ethic “seems entitled to stop at the high-tide line” (Safina 2003, 2) and emphasizes the organisms that live and grow on terra firma, as opposed to those in the water or air. As such, Leopold’s land ethic can and should be connected to the sea as “connectivity is perhaps the main single characteristic of Earth’s singularly life-giving ocean” (Safina 2003, 2). Without the ocean on this planet, there likely would be no life, so we must also extend respect towards the sea such that the land ethic becomes a land-and-sea ethic.

Concerning this, extending “a sea ethic would mean recognizing the ocean’s importance to the continued existence of life on our planet and to human futures” (Safina 2003, 5). Many species, if not all—including humans—are indebted to the ocean for the creation and evolution of life on this planet; due to this, we have a moral obligation to respect and protect the sea as fiercely as we may protect the land we live on. Furthermore, recognizing the ocean’s importance would bring a “sense of moral imperative, commitment, and urgency—urgency toward ending overfishing and wasteful bycatch and aggressively rebuilding depleted ocean wildlife populations,... slowing habitat destruction,... and implementing networks of protected areas in the sea” (Safina 2003, 5). Our current relationship with the ocean, as a society, is not the most respectful one as humans have exploited marine resources to the detriment of their diversity and survival. Overfishing, wasteful bycatch, and depleted populations are just some of the many issues impacting the ocean while still lacking a sea ethic or ecocentric perspective.

In order to fix our current relationship with the ocean, as a society we need to change how we think about the natural world and how we interact with it. We need to remember that human beings are a part of nature too and that any interaction we have with the rest of the natural world, positive or negative, will come back to impact us. Balancing our anthropocentric worldview with a more holistic, ecocentric perspective is one step we can take towards a better world. When we think about the philosophy, the economics, and the science of the natural world, we need to do so holistically, both disciplinarily and in the context of ecocentrism.

Chapter 2: The Tragedy of Common Property Marine Resources

“There is no polite way to say that business is destroying the world.” – Paul Hawken

The economics of natural systems is an important aspect of environmental ethics, science, policy, and how we interact with non-human nature. Environmental economics looks at how policy and economic activity influence the environments in which we live, including the natural resources we harvest, such as common property resources. It is important to recognize the economics of oceanic systems, like fisheries and their corresponding ecosystems, and how our interactions impact them. For example, anything we do to protect marine ecosystems and their organisms, like sharks, must take economics into account, and we must remember that people have an economic stake in the protection of these resources.

What Are Common Property Resources?

While some common property resources may initially go unnoticed as aspects of shared systems, they are key components to how the world works and are part of our everyday lives. Examples of these systems include forests, pastures, the atmosphere, water, irrigation systems, and fishing grounds. Shared-resource systems, also known as “common property systems” or “common-pool resources,” are natural resources owned and managed collectively by a society or community, rather than by individuals (OECD 2001). While in Colorado and areas of the western United States a forest may belong to a specific

territorial division or county rather than an individual, members of the public are generally allowed to traverse and frequent the area, and some members may even have a license to harvest its resources, which can be used and purchased by other people. This same concept is applied to the ocean as a whole as the ocean and its resources cannot be owned by any individual; the resources produced by the sea are relatively available for harvest by anyone.

Much of the ocean is considered to be common property, even within the Exclusive Economic Zone (EEZ) of an individual country such that the resources found within that country's domain are shared among groups and citizens of said country, but not owned by specific individuals. Within an EEZ, local and commercial fishermen are given licenses to fish within their country's territorial waters, but no singular company can say that only *they* are allowed to harvest cod or tuna. The opportunity to harvest these fish belongs to a community of people. Despite being considered shared resources, they are not shared equally throughout the system, which can create environmental and economic issues when competition is involved. As such, common property systems are vulnerable to overexploitation and a situation Garrett Hardin (1968) titled the "Tragedy of the Commons."

The "Tragedy of the Commons" occurs in a shared-resource system where individual users act independently according to their self-interest, and therefore behave contrary to the common good of a community by spoiling or depleting the shared resource through their collective action. This can or will eventually lead to a crash in resource supplies. Concerning marine environments, the oceans of the world suffer from this philosophy as maritime nations still respond to the principle of the "freedom of the seas"

(Hardin 1968). As many still believe in the inexhaustible resources of the oceans, fisheries bring species after species of whales, fish, sharks, and other marine organisms closer to extinction. Even with regulation, a commercial fishery cannot fail to diminish the fish stock (Gordon 1952) and in an unregulated system, the Tragedy of the Commons is inevitable (Berkes 1985). Furthermore, the Tragedy is more likely to occur in areas of shared resources that are difficult to regulate or monitor, such as the High Seas.

The “High Seas”

While there are areas of the ocean that belong to a certain country, such as internal and territorial waters and a country’s EEZ, much of the ocean is outside of national jurisdiction (Gjerde et al. 2013). These areas are referred to as the “High Seas,” a legal term meaning “oceanic waters beyond the limits of territorial and/or economic jurisdiction of a state” (Game et al. 2009, 1). The High Seas are also areas where a “traditional regime of freedom of the seas applies” (UNCLOS cited in Druel and Gjerde 2014, 90).

Many people—including policymakers, researchers, and the general public—might think, “Who will be in charge of these areas if no one country has jurisdiction over them?” As such, the High Seas are sometimes overlooked in marine conservation and the creation of marine protected areas (MPAs) due to difficulties in managing the protection of these systems, but this does not make these areas any less important than those within a country’s EEZ or territorial waters. Many migratory species inhabit the High Seas, particularly many tuna species, rays, and oceanic sharks, such as the Basking Shark (*Cetorhinus maximus*), the Dusky Shark (*Carcharhinus obscurus*), the Manta Ray (*Manta birostris*), the Whale Shark (*Rhincodon typus*), and the Great Hammerhead Shark (*Sphyrna mokarran*).

Not only do migratory species inhabit and traverse the High Seas, but the percentage of depleted and overexploited stocks is more extreme for many fish species caught in the High Seas (Gjerde et al. 2013). According to the Food and Agriculture Organization (FAO) of the UN (2007), “one third of highly-migratory tuna and other tuna-like species are overexploited... and more than half of the highly-migratory oceanic sharks and nearly two thirds of the straddling stocks [that cross multiple EEZs] and other high-seas fishery resources are overexploited or depleted” (cited in Gjerde et al. 2013). The High Seas make up two-thirds of the world’s oceans (Karan 2018), as such, they are easily overexploited. According to FAO’s 2020 report on overfishing statistics, the total of marine fish caught globally reached “the highest level ever recorded at 96.4 million tonnes” in 2018. Paul Greenberg noted in his book “Four Fish,” that today, the total harvestable catch of the world’s oceans is cited at approximately 90 million tons, but some in the scientific community believed as recently as the 1970s that 450 million tons of seafood could be harvested from the oceans per year—five times the current maximum harvestable amount (2011). Overfishing is a particularly large problem in these areas as there are few agencies or organizations that govern High Seas fishing to prevent overexploitation, despite there being regional fisheries management organizations (RFMOs) and other bodies that manage these fisheries.

In fisheries with little regulation and open-access fisheries, where access to the fishery is unrestricted and the right to harvest is free and open to all, particularly in the High Seas, many fish stocks are overharvested. While the High Seas Fishing Compliance Act requires all US registered fishing vessels to have a permit to fish on the High Seas and

that those permit holders are required to record all fishing efforts (NOAA 2020, “High Seas Fishing...”), it does not stop illegal, unreported, and unregulated (IUU) fishing from occurring, further wreaking havoc on marine ecosystems. This has caused the decline and collapse of many oceanic fish stocks, such as Pacific, Atlantic, and Southern Bluefin Tuna (WWF 2020, “Tuna: Facts”) leading to a “Tragedy of the Commons.” Furthermore, in “Launching a Sea Ethic,” Dr. Carl Safina noted:

And because the fluid surface is not friendly to fences, and animals roam massively within, it fosters the creation of the largest human commons anywhere: the waters of the continental shelves and high seas wherein is executed the largest-scale commercial hunting of wildlife on Earth. (2003, 4)

These areas and their organisms are vulnerable to anthropogenic influences and overexploitation, and we must protect the ecosystems and communities of the High Seas to prevent the further tragedy of “the largest human commons” (Safina 2003).

The “Tragedy of the Commons”

For a long time many people thought that the ocean’s resources, particularly marine fisheries themselves, were inexhaustible and that “any attempt to regulate these fisheries seems consequently, from the nature of the case, to be useless” (Huxley 1883, cited in Gordon 1952, 126). In the late 19th century, there was relatively little fishing restriction in European waters; after the Royal Commission of 1866, England had repealed many restrictions on fisheries (Gordon 1952). Not only was the inexhaustibility of the sea a widely held belief, many people thought that commercial fishing did not affect the population of the sea at all. Today we know that this is incorrect as man’s intrusion has the same effect on the population of a potential fishery as any other predator in the sea.

Fisheries ecology and management recognize the effect that harvesting has on fish stocks whether commercial or not, but a natural reserve of fish and a fishery are inherently incompatible and it is important to remember that “the exploitable stock of fish is a changeable quantity, which depends on the intensity of the fishery” (Gordon 1952, 128). The more resources we take from the sea—fish, sharks, minerals—the less remains, and vice versa. On the other hand, fish populations are renewable and respond to resource availability as well, so fish stocks can be replenished over time. Furthermore, each fishery tends to harvest at a different intensity than another. For example, fisheries concerned about sustainable harvest tend to follow the concept of maximum sustainable yield (MSY), which is the maximum level that a resource can, theoretically, be routinely harvested or exploited without its long-term depletion (Maunder 2008). MSY is dependent on the environmental conditions of the ecosystem; thus, the MSY for a specific fishery can change from year to year, depending on the population size (i.e. number of an individual species occupying a defined area) at the maximum rate of growth (Pew Charitable Trusts 2012). Additionally, MSY depends on the maximum rate of fishing mortality (i.e. the proportion of a fish stock harvested via fishing), the harvestable stock of that fishery (i.e. the catchable individuals of a certain species that support the fishery), and the rate of reproduction of that species (Pew Charitable Trusts 2012). While MSY helps keep many fisheries at more sustainable levels than those that are unregulated, it is not a panacea for sustainable fishing and preventing the Tragedy of the Commons. For instance, marine species that cannot reproduce quickly enough to meet the demand for their harvest, such as sharks and whales,

are subject to overexploitation and the MSY for these organisms can be easily surpassed as bycatch in non-target fisheries.

Most of the problems associated with depletion, overexploitation, and conservation of marine resources are manifestations of the fact that the sea's natural reserves yield no economic rent as the ocean is a shared-resource system (Gordon 1952). Economic rent is any payment to a particular economic factor (e.g. fish, land, a worker, etc.) exceeding the minimum cost necessary to bring that factor into production; this is essentially—under its present use—the excess amount earned by a resource. The reason Gordon (1952) states that the seas “yield no economic rent” is that most of the world's oceanic fisheries (High Seas) are lacking in private property rights in their underlying natural resources or complements like harvesting volume (Arnason 2011). This is also because capture fisheries “are based on fish stocks found in nature” (Arnason 2011, 213), as opposed to aquaculture-based fisheries which involve cultivating or rearing aquatic plants and animals for food. Consequently, because capture fisheries are reliant upon naturally found fish stocks, they are highly susceptible to the Tragedy of the Commons.

Despite the inevitability of the Tragedy, this situation can still be overcome and ameliorated, if not mitigated. Furthermore, some evidence has suggested that the Tragedy of the Commons is not universal and that in areas where local fishers manage fishing grounds, without much governmental influence, they can prevent overfishing via community-based systems (Leal 1996). The problem of overfishing and the collapse of marine resources has its roots in the economic organization of the industry (Gordon 1952), as well as the philosophical perspectives that society has surrounding marine resources. In

1951, Dr. Martin D. Burkenroad stated that “the management of fisheries is intended for the benefit of man, not fish” and that its effect upon fish stocks “cannot be regarded as beneficial,” but this is wrong. The management of fisheries, while perhaps originally intended for human benefit, is also intended for the benefit of the fisheries resources and any management strategy that only focuses on the economic benefit to humans is inherently lopsided. The management of fisheries does have a beneficial effect on fish stocks and humans as we need to manage, conserve, and protect fish stocks for the benefit of the fish first in order to benefit us as well.

When most people hear the phrase “fisheries management,” they may assume it refers primarily to regulations developed by the government, and while there are many regulations like the Sustainable Fisheries Act of 1996, not all fisheries management is government-based. As noted earlier, some fisheries with community-based management exist, such as fisheries co-operatives or “co-ops.” These fisheries co-operatives are run voluntarily by a group of members comprised of fishers and customers who pool their resources, and the fishermen are allotted a specific amount of fish to catch to prevent one group from monopolizing it all (Robinson 2014). One example is a co-op based in Brighton, England called “Catchbox,” where the fishers agree (in advance) on a maximum amount of fish that can be harvested and sold and everyone who joins the co-op pays an initial one-time membership fee; customers agree on an amount of fish they would like weekly or biweekly and pay upfront for it (Robinson 2014). This helps to prevent an excess of harvested fish and keeps the catch at more sustainable levels compared to larger commercial fisheries. Fishing co-operatives such as these also help to provide a stable

income for fishermen who would otherwise have to compete in the larger market to sell their harvest, as well as help reduce the bycatch of non-target species, provide education about fishery regulations, and provide monetary opportunities for impoverished coastal communities (Robinson 2014, Basurto et al. 2013).

If fisheries management is primarily human-focused rather than balanced between human benefit and ecosystem benefit, the Tragedy of the Commons would still be likely to occur due to the pattern of competition among fishermen. On the other hand, if such management were balanced between benefitting us and the fish, or if more fisheries were community-based (e.g. co-ops), the Tragedy may be avoided by protecting those marine resources being harvested. Competition cannot be eliminated in such systems, but it can be controlled such that it is less likely to get out of hand. Through conservation measures, education, and further regulation of local and commercial fisheries, as well as an adjustment to the economic organization of the industry, the Tragedy of the Commons may be circumvented. In our efforts to mitigate and transcend the Tragedy and protect marine ecosystems, it is important to remember and recognize that our economic activity influences the environments in which we live and vice versa because we are members of the ecological systems that surround us. We must also consider the fact that anything we do to protect marine ecosystems and their organisms, such as through fishery regulation, depends on the environmental economics and the stakeholders who benefit from each system.

Chapter 3: The Gravity of Shark Conservation: On Finning & Fisheries

“Sharks are beautiful animals, and if you’re lucky enough to see lots of them, that means you’re in a healthy ocean. You should be afraid if you are in the ocean and don’t see sharks.”

– Dr. Sylvia Earle

Science and environmental policy often go hand-in-hand and in marine ecosystems the ecology of a biological community is paramount for the development of laws that protect the environment and its organisms. In caring about the health of our oceans, we must recognize that shark species are vital to these systems. The importance of sharks is sometimes ignored by the general public due to the harmful stereotypes surrounding these animals, causing many people to believe that sharks do not have necessary roles in their ecosystems and that they are only present as destructive and dangerous killing machines. This is incorrect because sharks are integral members of their communities and are fundamental to many marine ecosystems. We need to look at these systems as systems of which we are a part and consider how we interact with their megafaunal components.

Sharks and their Ecosystems

Sharks belong to a subclass of chondrichthyans—fish with cartilaginous skeletons—known as Elasmobranchii, which also includes rays, skates, and sawfish. There are over 1,000 species of elasmobranchs inhabiting a wide range of marine—and some freshwater—habitats such as coral reefs, warm-temperate seas, estuaries, the open ocean

(pelagic), and the deep ocean. Unfortunately, due to overexploitation, rising demand for shark fins, and lax regulations on finning, many species are now legally listed as threatened and endangered. At least 15% of all shark species have been listed on the IUCN Red List as “Vulnerable,” “Endangered,” or “Critically Endangered” (IUCN 2010, cited in Gallagher & Hammerschlag 2011). The EPA describes endangered species as “those plants and animals that have become so rare they are in danger of becoming extinct,” whereas threatened species are those that are “likely to become endangered within the foreseeable future” (2019, “Endangered Species”). According to the World Wildlife Fund (2020), at least 38% of pelagic shark species and 26% or more of the 482 species of sharks and rays inhabiting reefs, coastal areas, and continental shelves are threatened with extinction. Additionally, the conservation status of at least 35% of these coastal species is unknown, so there may be many more endangered species (WWF 2020, “WWF Sharks”).

Due to their slow-growth, long gestation period, and small number of young, elasmobranchs are very vulnerable to overexploitation and have limited potential to recover from certain threats, such as overfishing and habitat degradation (Barbosa-Filho, Costa-Neto & Siciliano 2016, Passantino 2014, Gallagher & Hammerschlag 2011). For example, Dusky and Sandbar Sharks (*C. obscurus* and *C. plumbeus*, respectively) mature around 20 to 25 years of age and can live up to 50 years (VIMS n.d., “Sandbar Shark”; VIMS n.d., “Dusky Shark”). The Sandbar Shark mates in spring to early summer, has an 8 to 12-month gestation period, and gives birth to 6 to 13-pup litters. Dusky Sharks mate every 2-3 years, have an 18 to 22-month gestation period, and give birth to 3 to 16-pup litters (VIMS n.d., “Sandbar Shark”; VIMS n.d., “Dusky Shark”). This vulnerability is common to many shark

species and makes their need for protection even more crucial due to the important roles they have in their ecosystems.

Oftentimes, sharks act as ecosystem engineers or keystone species to maintain balance throughout their ecosystems, removing sick or weak individuals from prey species populations, regulating species distribution and diversity, and keeping the carbon cycle moving in the instances of scavenger species like the deep-sea Greenland Shark (*Somniosus microcephalus*). Drastically reducing shark populations can have negative impacts on local environments and economies as predator removals and declines can cause large-scale changes in communities by altering predator and prey abundances (Heithaus, Wirsing & Dill 2012). Sharks are important members of their communities and loss of shark populations can result in the failure of certain ecosystem services depending on the niche they fill as not all shark species are apex predators (Bornatowski et al. 2014, Myers et al. 2007); some are mesopredators and others, like the Whale Shark (*Rhincodon typus*), act as micropredators of krill and other plankton.

Top predators, such as the Dusky Shark, often exert predation pressure known as top-down control, meaning they have strong effects on trophic and community dynamics from the highest to the lowest trophic levels (Heupel et al. 2014). Eliminating them can release mesopredator prey populations from predatory control (Myers et al. 2007). Instances such as these can cause organisms in lower trophic levels to become overabundant. For example, Cownose Rays (*Rhinoptera bonasus*) after the loss of apex predators such as Hammerhead Sharks (*Sphyrna* spp.) can become overabundant and consume more prey, like bivalve mollusks. This can influence commercial and local

bivalve fisheries, impacting the humans and other animals that rely on bivalves for food. Other shark species have populations that are affected by prey availability, which can shift the spatial habitat of prey, altering the feeding strategies and diets of other species. Not only can removing species from their habitats cause shifts in food-web dynamics, but it can also lead to small-scale extirpation—local extinction—and reduce the biodiversity and resilience of an ecosystem (Gallagher & Hammerschlag 2011).

Conservation of shark species, particularly apex and mesopredators such as the Dusky Shark, Sandbar Shark, and the Grey Reef Shark (*C. amblyrhynchos*), will help increase biodiversity and balance the health of many marine ecosystems and communities (Myers et al. 2007). Shark conservation can also help maintain coral-reef and seagrass habitats as loss of sharks can cause declines in the biodiversity of coral reefs and seagrass beds and can lead to declines in commercial fishery stocks. Furthermore, protecting and restoring marine habitats can provide many benefits to the global human population, such as providing seafood meals for up to 1 billion people, providing livelihoods for fishermen and others around the globe, regulating climate, and absorbing carbon dioxide (Oceana 2020, “What We Do”). It is important to recognize the role of sharks in this cycle as the protection of sharks can help protect their entire ecosystems, which can end up helping other organisms in the global biotic community, including humans, due to the interconnectedness of the natural world.

Finning and Fisheries

Approximately 100 million sharks—those who are threatened with future extinction and those who are not—are killed each year due to commercial fishing, finning,

and bycatch from these industries, tens of millions just for their fins alone (Fairclough 2013, Kettles 2011, Oceana 2010). Shark finning is a wasteful and unethical practice whereby someone cuts the fins off of a shark and dumps the body back into the ocean, leaving the disabled animal to drown, be eaten by other predators, starve, suffocate, or bleed to death (Spiegel 2001, Fairclough 2013). Although mostly caught for the fins, people in a few regions consume shark meat and may rely upon non-finning, sustainable fishing practices for less vulnerable species or those with larger populations. Fisheries, in contrast, target and harvest sharks for more than just fins, including meat, liver, skin, and teeth for personal, cultural, or commercial use. According to Gallagher and Hammerschlag (2011), due to target and non-target commercial fishing, shark populations along the east coast of the United States have declined approximately 80 to 90% since the mid-1980s, not to mention population declines in other areas around the world.

Shark fins have a high monetary and cultural value—particularly in Asia—and countries such as China have been experiencing economic booms, causing demand for shark fins to rise drastically (Fairclough 2013, Spiegel 2001) as historically, shark fins were a status symbol, and the wealthy would use shark fin soup to present their high status to others. Because of this, shark fins are also far more valuable than the rest of the body (Passantino 2014, NOAA 2020), sometimes selling for \$500 or more per pound (Fairclough 2013), whereas other shark meats can range from \$1.13 to \$7.90 per 2.2 pounds (equal to one kilogram) in European markets (Kettles 2011). Aside from harvesting fins and meat, shark species provide non-consumptive use potential, as there has been an increase in shark-influenced ecotourism in recent years (Gallagher & Hammerschlag

2011), as well as sport and trophy fishing. For example, Sandbar and Dusky Sharks are targeted by sport and commercial fishers for a variety of uses and are often caught as bycatch from other fisheries, like menhaden. In addition, sharks are caught for leather and liver oil (Dent 2015), which came from demand for vitamin A in the late 1930s; efforts for which were abandoned in the 1950s due to synthetic vitamin development (McCandless et al. 2014). Other common uses include traditional weapons, medicines, and tourist trinkets such as shark tooth necklaces.

Additionally, the cosmetic industry has become increasingly reliant in the past 40 years on shark-based squalene, a natural oil that protects the skin barrier and is believed to have antioxidant properties (Shark Allies 2020, “What is Squalene?”). Squalene is commonly found in shark liver oil and plants such as sugarcane and olives, although sharks are considered to be the cheapest source (Shark Allies 2020, “What is Squalene?”). Squalene is also used in vaccines such as those being developed for COVID-19 as an adjuvant: a “boosting” agent that improves the immune response, making vaccines more effective (Meneguzzi 2020). One ton of squalene requires approximately 2,500 to 3,000 shark livers (Meneguzzi 2020), and approximately 2.7 million shark livers are harvested yearly for cosmetics and vaccine boosters (Shark Allies 2020, “What is Squalene?”). This demonstrates that people in developed countries, such as the United States, are just as responsible for exploiting sharks as people in Asian countries and developing countries are and that we are all to blame, not just certain people.

While shark fins are mostly harvested and exported to Asian countries where they hold important cultural value, other major exporters and importers of shark meat include

European and South American countries like Spain and Brazil, where this product is often a cheaper alternative to other harvested fish species (Dent 2015). Western countries, including the United States, also participate in the shark fin trade (both legally and illegally) by scarcely inspecting large quantities of seafood traveling to and from Asia, some of which were revealed to be dried and salted shark fins (Bittel 2019). The 1970s saw an increased global demand for fins, meat, and cartilage, leading to commercial fishery expansion and controversial finning practices. As a result, stocks began showing signs of decline in the 1980s even as tuna and swordfish vessels began keeping higher amounts of shark bycatch (McCandless et al. 2014). In terms of bycatch, sharks are often caught and killed by indiscriminate fishing gear like large-mesh gillnets or pelagic longline gear, which can range from 5 to 40 miles in length with 20 to 30 hooks per mile, an easy way for fishers to capture multiple organisms with less effort than some other methods. Other common shark fishing methods include bottom longline gear, which is the primary commercial gear for large coastal sharks (LCS), and hand-gears like harpoons or handlines, though these are less common (McCandless et al. 2014). Along with sharks being caught in both target and non-target fisheries, most fisheries are often small, unmonitored, and located in poor regions, except for some developed countries like Spain and the U.S. (Yulianto et al. 2018). Furthermore, research shows that 65% of the shark catches in Indonesia are young individuals that have not reached sexual maturity, suggesting the unsustainable nature of these fisheries (Arai & Azri 2019, Lam & Sadovy de Mitcheson 2011).

In the United States, both Sandbar and Dusky Shark fisheries are sustainably managed, but outside of the U.S. there are fewer restrictions and catch is unsustainable since most shark species cannot reproduce quickly enough to meet the demand of their harvest. As many shark fisheries are located in poor regions and developing countries, local fishermen rely on them for their livelihood. For example, in Indonesia, targeted shark catch is a banned practice, but fishermen tend to ignore the ban as this activity is one of the few practices able to economically sustain them (Yulianto et al. 2018). Figure 2 below shows the total catches of Dusky Sharks in the Gulf of Mexico (GOM) and U.S. Atlantic oceans, separated into commercial catches, recreational, and discards (i.e. finning) from 1981 to 2009. Figure 3 shows the total catches of Sandbar Sharks in the U.S. Atlantic and GOM, including recreational, reported commercial, and unreported commercial catches from 1978 to 2008. In both cases, the catch declined over time as the population also declined. Moreover, sharks' reputation as voracious apex predators increases the prestige of their capture and enhances their trade value, but also inspires respect and the need for protection and conservation due to their vulnerability.

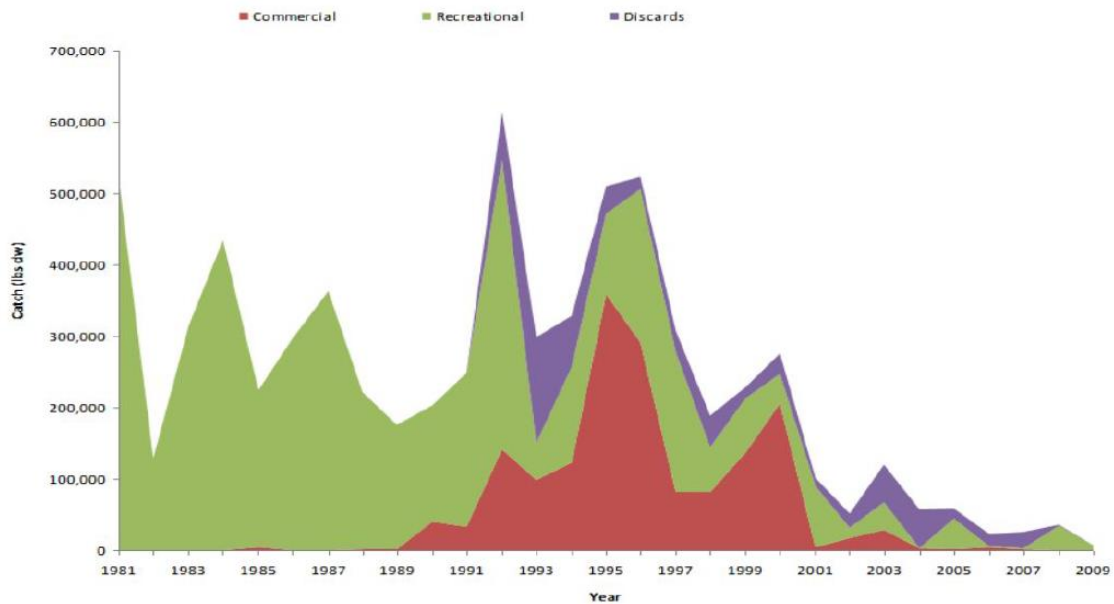


Figure 2. Total catches of Dusky Shark from the GOM & U.S. Atlantic commercial & recreational fisheries, 1981-2009 (in pounds dressed weight) (McCandless et al. 2014). Red = commercial, green = recreational, purple = discards from finning.

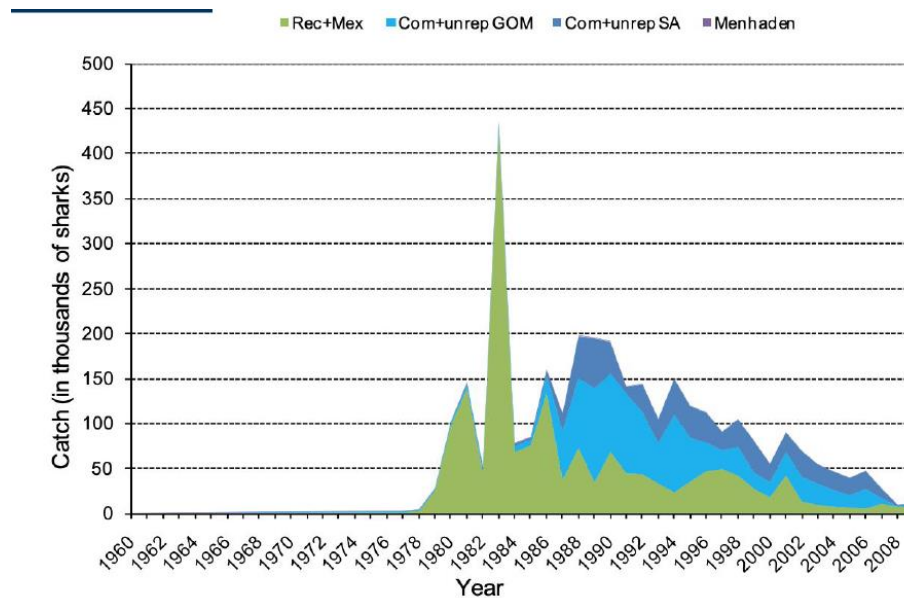


Figure 3. Catches of Sandbar Sharks (in thousands of sharks) by fleet, separated into four fisheries: commercial & unreported catches in the Atlantic (dark blue), commercial & unreported catches in the GOM (light blue), menhaden fishery discards (purple), and recreational & Mexican catches (green), 1978-2008 (SEDAR 2011).

While there are a few regional, national, and international restrictions on shark fishing and finning, as well as the trade or possession of shark fins, there is no global regulation prohibiting the practice of finning (Spiegel 2001, Clarke et al. 2012). Of the present environmental agreements for regulation and conservation, many reflect differing degrees of protection, yet protection measures are not always legally binding for the parties in the contracts (Passantino 2014). Some regulatory agencies, such as the Western and Central Pacific Fisheries Commission (WCPFC)—a regional fisheries management organization—attempt to prohibit finning by ensuring that carcasses are not disposed of at sea while fins are kept by mandating that members “have on board fins that total no more than 5% of the weight of sharks on board up to the first point of landing” (Clarke et al. 2012). This means that while vessels are allowed to have some fins on board, sometimes due to on-board processing, the majority of the catch must not be made up of shark fins. Other examples of finning and fishing regulations originate from government organizations such as CITES, the Food and Agricultural Organization of the UN, and NOAA, among others.

One example of government-based regulations in the United States includes the Magnuson-Stevens Fishery Conservation and Management Act (MSA)—the main law governing marine fisheries management in U.S. federal waters—which has key objectives of preventing overfishing, rebuilding overfished stocks, ensuring safe and sustainable seafood supplies, and increasing long-term social and economic benefits (NOAA 2020, “Magnuson-Stevens Act”). Revisions to the MSA include the addition of the Sustainable

Fisheries Act (SFA) of 1996, Shark Finning Prohibition Act (SFPA) of 2000, and the Shark Conservation Act (SCA) of 2010, the latter of which requires all sharks in the U.S.—except the Smooth Dogfish (*Mustelus canis*)—be brought to shore with their fins naturally attached. This act has both international and domestic provisions that help create sustainably managed shark fisheries while also removing finning practices.

Another important piece of regulation for more than just marine species includes the Endangered Species Act (ESA) of 1973, whereby the federal government has the responsibility to protect threatened species, endangered species, and critical habitat. Critical habitat is defined as specific geographic areas containing “features essential to the conservation of an endangered or threatened species and that may require special management and protection” (USFWS n.d., “Endangered Species”). Multiple shark species are listed as threatened or endangered via the ESA, such as the Daggenose Shark (*Isogomphodon oxyrhyncus*), Oceanic Whitetip (*Carcharhinus longimanus*), Scalloped Hammerhead (*Sphyrna lewini*), and the Sawback Angelshark (*Squatina aculeata*). Unfortunately, many shark species that are listed as vulnerable, endangered, or critically endangered by international agreements like the International Union for Conservation of Nature (IUCN) or CITES are not listed as endangered by the United States or protected by the ESA, such as the Sandbar Shark, Dusky Shark, Whale Shark, Basking Shark, Pondicherry Shark (*Carcharhinus hemiodon*), and the Great Hammerhead (*Sphyrna mokarran*).

One of the most important international components of prohibiting finning and the trade of shark species comes from the Convention on International Trade in Endangered

Species (CITES), which is legally binding for the 80+ countries involved, meaning they must implement the Convention to ensure that trade in endangered species is sustainable and/or does not threaten their survival (CITES n.d., “What is CITES?”). CITES protects the trade of multiple shark species, such as the Silky Shark (*Carcharhinus falciformis*), Oceanic Whitetip, Basking Shark, Bigeye Thresher Shark (*Alopius superciliosus*), Longfin Mako Shark (*Isurus paucus*), and the Great White Shark, among others. Like the ESA, it does not protect all shark species with depleted populations that are vulnerable to future extinction, such as the more commonly used commercial species like the Dusky or Sandbar Shark.

Although the United States has highly regulated fisheries and multiple laws regarding the species and amount of those species that can be harvested, there are still areas where illegal, unreported, and unregulated (IUU) fishing can occur, particularly in other areas around the world, such as developing countries and artisanal fisheries, where regulation is lax or unenforced. According to NOAA (2020), IUU fishing products “often come from fisheries that lack the strong and effective conservation and management measures that U.S. fishermen are subject to” and that it most often violates management and conservation measures like bycatch limits or quotas established under international agreements. IUU fishing negatively impacts marine ecosystems, fisheries, coastal communities, and food security by undermining international and domestic conservation and management (NOAA 2020, “Illegal, Unreported, and Unregulated Fishing”). Because many fish stocks—including sharks—have already been overexploited via legal harvesting activities, IUU fishing puts these stocks under additional pressure, and non-target species

such as Bryde's whales (*Balaenoptera brydei*), Whale Sharks, dolphins, rays, turtles, and other shark species are often trapped in the illegal fishing nets (Sea Shepherd 2018, "About IUU Fishing"). These non-target, unwanted species—AKA "bycatch"—are tossed back into the ocean, often dead from net entanglement. In the Pacific Ocean alone, approximately 3.3 million sharks are caught yearly as bycatch via longlines and sharks are the most significant bycatch species in the world's major High Seas fisheries (WWF n.d., "Bycatch Victims"). Additionally, in the northeast Atlantic Ocean, 80% of Thresher (*Alopias* spp.) and White Sharks and 89% of Hammerhead Sharks have disappeared in the past 20 years due to bycatch (WWF n.d., "Bycatch Victims"). Bycatch is an externality of the fishing and finning industry such that it is a consequence of commercial fish harvest and is not reflected in the cost of the other fish involved. Although it is different from finning and fishing for shark meat, bycatch is another example of how shark health is tied to the overall exploitation of marine resources.

Bycatch and shark finning are important environmental issues that require us to recognize the impacts that our actions can have on an ecosystem and its organisms. These environmental issues are impacted by the economics of the industry as well. Some believe that "environmental factors are so much more important than commercial fishing that man has no effect on the population of the sea at all" (Gordon 1952, 126), but this is simply not true. Sharks have intrinsic value in their environment and economic value for humans, but we must remember that the ocean and its organisms are important to the continued existence of life on Earth and human futures (Safina 2003). To mitigate and overcome these environmental and economic issues, we must care about the health of our oceans as a whole

and remember that each species has a role to fill in order for the ecosystem to function properly. Megafauna, such as sharks, are very important elements in their ecosystems and they must be taken into consideration when we analyze our scientific, economic, and policy interactions with marine environments, as well as how they can influence us.

Chapter 4: Marine Ecological Tourism

“I can mention many moments that were unforgettable and revelatory. But the most single revelatory three minutes was the first time I put on scuba gear and dived on a coral reef. It's just the unbelievable fact that you can move in three dimensions.” – David Attenborough

Humans and the natural world are connected; they rely upon each other just as science, ethics, and economics do. When interacting with marine life, we often draw upon scientific knowledge and societal values, creating experiences and forming relationships with nature that can shape our perspectives and future connections. Outside of local or commercial harvest of marine life, we can encounter the ocean and its organisms in myriad ways, including ecological or nature-based tourism. Ecological tourism relies upon environmental ethics, science, and economics and it is necessary to achieve human-nature holism in this industry on account of the many impacts it can have on the natural world and the economy. Experiencing nature in this way has the potential to increase our appreciation of and respect for nature, providing intrinsic and non-extractive instrumental merits, together valuing the sustainability and continuation of ecosystems and their organisms.

What is Ecotourism?

Ecological tourism, more commonly known as “ecotourism,” is a form of nature-based tourism or environmentally responsible travel to experience and appreciate nature

(Fennell 2015, Gallagher & Hammerschlag 2011). Not only is ecotourism environmentally responsible, but it is travel to natural areas that can improve the well-being of local people and have an important role in conserving the environment (Pookhao 2013). Ecological tourism and other forms of nature tourism or sustainable travel have origins in the environmental movement of the 1970s, similar to the origins of environmental ethics, but ecotourism did not become a popular travel concept until the late 1980s (Briney 2020). Around this time, environmental awareness increased and more people traveled to natural locations rather than to already established tourist locations.

According to The International Ecotourism Society (TIES), the largest and oldest ecotourism society in the world, a trip must meet specific principles to be considered “ecotourism.” For instance, the society states that ecotourism involves minimizing the social, behavioral, and physical impact of visiting the location (such as the use of roads), building environmental and cultural respect and awareness, and providing positive experiences for both hosts and visitors (TIES n.d.). Ecotourism must also provide direct financial benefits for conservation and local people, provide empowerment and other benefits for local people and the private industry, and raise travelers’ sensitivity and awareness to the host countries’ political, social, and environmental climates (TIES n.d.). Other principles of ecotourism in agreement with the Society may also include designing, constructing, and operating low-impact facilities, and recognizing the rights and spiritual beliefs of the indigenous people in the community (TIES n.d.).

On the other hand, the term “ecotourism” can be used in a variety of ways and does not always refer to an environmentally benign activity (Acott, La Trobe, & Howard 1998),

sometimes being confused with other forms of nature-based tourism that share similar values like sustainability or use the same settings (Fennell & Nowaczek 2010). One example of this is when it is used as a marketing term to sell products that depend on mass tourism or can cause cultural and environmental degradation (Acott, La Trobe, & Howard 1998). The term itself does not differentiate between “ecotourism that verges on a form of mass tourism and genuine attempts at environmental tourism” (Acott, La Trobe, & Howard 1998, 239). To differentiate the two, Acott, La Trobe, & Howard (1998) use the terms “shallow ecotourism” and “deep ecotourism” to recognize that differences exist between the values held by the activities at ecotourism sites and potential ecotourists, as deep ecotourism is more environmentally benign and shallow ecotourism can cause more harm than good. One example that Acott, La Trobe, & Howard (1998) give for deep ecotourism is a low-impact “eco-traveller, back-packing, pursuing a minimal impact experience,” whereas shallow ecotourism may include a group of people “on a bird watching holiday,... staying in luxury hotel accommodation, expecting a westernised holiday experience” (238). This is not to say that shallow ecotourism is entirely negative towards the environment as it can still provide multiple benefits in terms of boosting local economies and providing educational experiences, but the negative environmental impacts can be significant. People can still reduce the negative environmental impacts of shallow ecotourism if they support companies that actively attempt to mitigate their impacts on the environment, such as using renewable energy or supporting local farmers rather than sourcing food internationally, among other actions.

Ecotourism exists in many different forms and locations worldwide, including Central and South America, Madagascar, and Indonesia (Briney 2020), and can also be parsed into specific industries, such as marine wildlife tourism, forest ecotourism, and agricultural ecotourism. Marine wildlife tourism is considered to be a rapidly growing, profitable market that considers environmental conservation, reducing environmental impacts, and promoting local communities' interests. It includes myriad activities, land-based, water-based, or both (Sakellariadou 2014). Examples of marine ecotourism include swimming or diving with sharks, snorkeling, fishing, cave diving, whale and dolphin watching, kayaking, sailing, underwater photography, sightseeing via boat or submersible, and visiting shipwrecks both below and above water (Sakellariadou 2014). Along with being diverse, marine environmental tourism has multiple benefits for local economies. Many ecotourists prefer to buy local goods, items, and handicrafts on their travels, which helps promote locally produced food, drink, and souvenirs as opposed to items produced outside of the country being visited. Marine ecotourism also promotes the use of existing facilities and infrastructure and provides new opportunities for skill-building and jobs for locals (Sakellariadou 2014). Marine ecotourism can promote environmental awareness, eco-friendly lifestyles, education, economic alternatives to activities responsible for environmental degradation, and helps raise funds to support marine research, environmental protection, and local conservation efforts (Sakellariadou 2014, Pookhao 2013).

In terms of specific economic benefits, marine ecotourism related to certain species can bring in money that helps support local economies and conservation efforts more

effectively and holistically than other economic-based interactions like fishing. For example, in the Bahamas, a Caribbean Reef Shark (*Carcharhinus perezii*) is worth a one-time value of \$50 when caught by a fisherman, but a live Reef Shark is worth approximately \$250,000 for dive tourism (Oceana n.d., “The Importance of Sharks”). Similarly, a single Whale Shark in Belize can have an economic value of \$2 million over its lifetime (Oceana n.d., “The Importance of Sharks”). Additionally, Cisneros-Montemayor et al. (2013) found that although global shark fisheries earn approximately \$630 million annually, numbers have been declining for the past decade and while shark tourism currently earns \$314 million annually, it is expected to continue its rapid growth, potentially earning \$780 million annually over the next 20 years. Not only is this a boon to local and global economies, but activities like shark diving promote the intrinsic value of these organisms and their ecosystems outside of economic value by helping to promote intrinsic environmental importance.

How Ecotourism and Conservation Are Connected

Marine ecological tourism and conservation go hand-in-hand because in principle ecotourism provides “effective economic incentives for conserving and enhancing biodiversity and helps protect the natural and cultural heritage of our beautiful planet” (TIES n.d.). Marine ecotourism encourages conservation and respect for natural systems, ensures ecological sustainability of shark populations, preserves shark habitats, builds environmental awareness through hands-on experiences, and creates livelihoods dependent upon environmental health including alternative livelihoods for local fishermen. For example, communities supporting marine conservation can transition from a fishing-based

economy to an ecotourism-based economy, such as on Isla Mujeres, Mexico where “instead of selling a fish, if you bring people to snorkel with that fish, you can make a sustainable living off of the life of the animal” (J. Vater, Interview cited in N. Geiling 2014, “Save the Sharks...”). In addition, Ceviche Tours, a company from Isla Mujeres, Mexico, is “committed to sustainable shark tourism, using Isla Mujeres’ location as part of the world’s second largest barrier reef system to promote shark education and conservation” (Geiling 2014, “Save the Sharks...”). John Vater, the head of Ceviche Tours, stated that “tourism is really the only product that Isla Mujeres has to sell” as swimming with whale sharks around the island has been a large economic benefit to the area which has few other economic options (Geiling 2014, “Save the Sharks...”).

In cases such as that of Ceviche Tours on Isla Mujeres, conservation and ecotourism are deeply reliant upon each other to support the livelihoods of local people and the biodiversity of the environment. Gallagher & Hammerschlag (2011) argue that as natural systems continue to be exhausted, this changes ecosystem capital, and the value of non-consumptive natural resource use (like shark diving, snorkeling, and angling) becomes progressively important in shaping and influencing local, regional, and international conservation efforts. For reference, ecosystem capital is the sum of all the services and goods provided to global human enterprises via natural systems (Gallagher & Hammerschlag 2011). This capital is dependent on the maintenance of ecosystem resilience and biodiversity. Other examples of non-consumptive resource use that increase ecosystem resilience and capital include marine protected areas and shark sanctuaries

(Cisneros-Montemayor et al. 2013), as well as citizen science research projects like Shark Trust's Shark Sightings Database (Shark Trust 2020).

Citizen science projects can be effective ways to merge local and international conservation efforts with ecotourism. For instance, Shark Trust's Shark Sightings Database enables individuals to record their shark sightings online from anywhere in the world, providing key resources for shark conservation and research (Shark Trust 2020). This project aims to generate important data for conservationists and researchers working with sharks, skates, and rays, which helps in the management and protection of these animals. It can be a great way for ecotourists to learn more about local shark species and become more engaged in their conservation.

Citizen science projects in conjunction with ecotourism are helpful ways to promote marine conservation and education around the world by impacting tourists and hosts in positive ways. On the other hand, marine-wildlife tourism does have some potentially negative impacts on the environment, but these often can be mitigated. Motorized boats may disturb or harm marine mammals due to propellers. Scuba divers and snorkelers may harm coral reef habitats if they are not careful while swimming and boat anchors can be dropped on coral reefs and harm the area if used irresponsibly (Sakellariadou 2014). Marine ecotourism can also increase litter and plastic waste, as well as environmental pressure: changes in the state of an environment due to a variety of factors such as natural climate variability, human influence, and ocean circulation (CSIRO 2020, "Environmental Pressures"). The consumption of natural resources due to the increased number of visitors, often traveling further to more remote settings, can also lead to increased carbon emissions

that may increase water acidity and decrease air quality (Sakellariadou 2014). These potential negative impacts are important to remember when considering our relationship to the environment, literally and philosophically.

Ecotourism in Relation to Environmental Ethics

While ecotourism is considered to be one of the most ethical forms of tourism (Fennell 2006, cited in Pookhao 2013), we must not forget the differences between deep ecotourism and shallow ecotourism suggested by Acott, La Trobe, & Howard (1998) (Table 1). There is an ongoing dilemma that reflects a conflict between anthropocentric and ecocentric values in this industry. Anthropocentrism is tied to placing instrumental value on things and ecotourism adds a non-extractive economic value to intact ecosystems and the persistence of species as opposed to harvesting natural resources (an extractive value). Achieving human-nature holism (i.e. a balance between ecocentrism and anthropocentrism) is necessary to recognize the intrinsic value in nature, which for many people often requires experiencing the thing being valued. The experience, whether direct or indirect (e.g. reading), is required to define what can be valued. Consequently, ecotourism can give value to non-human organisms in their natural environment, acting as a vehicle towards an ecocentric perspective and the consideration of intrinsic value by people.

Table 1. The relationship between typologies of environmentalism and sustainable development with deep and shallow ecotourism (Acott, La Trobe, & Howard 1998). The grey rectangle indicates a lack of information concerning (eco)tourism, environmental ethics, and the corresponding reference of that row.

Main reference	Deep ecotourism		Shallow ecotourism		Mass tourism
O’Riordan (1981), Pepper (1984)	Ecocentrism		Technocentrism		
Pepper (1996), O’Riordan (1989)	Gianism	Communalism	Accommodation	Intervention	
Pepper (1984)	Deep Ecologists	Self-reliance, soft technologists	Environmental managers	Cornucopians	
Dunlap and Van Liere (1978), Milbrath (1985)	New environmental paradigm		Dominant social paradigm		
Naess and Rothenburg (1989)	Deep ecology		Shallow ecology		
Pearce (1993), Turner <i>et al.</i> (1994)	Very strong sustainability	Strong sustainability	Weak sustainability	Very weak sustainability	

There is a relationship between the concepts of deep ecology, ecocentrism, and deep ecotourism, whereas shallow ecology, anthropocentrism (“Dominant social paradigm”), and weak sustainability are connected to shallow ecotourism and mass tourism (Table 1). For example, Nelson (1994) lists several principles and characteristics of ecotourism, some of which are directly related to environmental ethics, including the ideas that ecotourism “concentrates on intrinsic rather than extrinsic [e.g. economic] values” and that it is “biocentric [or ecocentric] rather than homocentric [i.e. anthropocentric] in philosophy.” Mass tourism relies upon humans placing instrumental or extractive value on natural resources, creating more environmental issues than both deep and shallow ecotourism. The instrumental and intrinsic values of nature can be tied together, creating a value of sustainability towards appreciating the continuation of nature. A sustainable balance of these values illustrates that ecotourism ecocentrically supports ecosystems’ and

organisms' ethical "rights" to continue, in-turn increasing people's appreciation for an ecocentric perspective. Additionally, a sustainable system of ecotourism can demonstrate both anthropocentrically and ecocentrically that the perpetuation of ecosystems and their organisms is necessary to continue providing substantial human benefits such as those provided by ecotourism. For instance, the economic benefits of ecotourism can only be maintained if the ecosystem is maintained. As such, a focus on increasing ecocentric sustainability in the ecotourism industry supports the balance between instrumental and intrinsic value in nature, both anthropocentrically and ecocentrically.

Ecotourism needs to incorporate an ethics-oriented, ecocentric perspective as this can increase resource and industry sustainability, promote sustainable practices in tourists, and integrate social, economic, and conservation goals (Pookhao 2013). Ecotourism itself promotes a wider acceptance of a sea ethic, which has the potential to provide broader effects on the industry and our perspectives of nature. A wider acceptance of Safina's Sea Ethic (2003), in turn, would help to move away from more environmentally harmful mass tourism by creating more sustainable and environmentally friendly interactions with marine ecosystems. Experiencing nature in this way has the potential to proselytize people towards a deeper appreciation of the natural world, a major value of ecological tourism, as experiencing something makes it more "real" for people, often making it more worthy of consideration. This helps in the long term by developing respectful and sustainable interactions with the natural world, such as through deep ecotourism and ecocentrism, actively working to mitigate the harmful impacts we have brought upon the ocean and its organisms.

Deep ecotourism and ecocentrism consider the common good of the plants, animals, and other organisms in an ecosystem, as well as humans, more than shallow ecotourism (Dobson 2011). Because shallow ecotourism or mass nature tourism may not be the best way to interact with the environment, many deep ecologists oppose ecotourism as they believe human-centered activities are out of step with the rest of nature (Pookhao 2013). Despite this, ecotourism can help promote local communities to place value on the preservation of their environment and natural resources, as well as demonstrate a balance between the environment and the economy through policy (Pookhao 2013). Policy and practice in ecotourism both seek to sustain the anthropocentric and ecocentric aspects of the industry, providing a balance between the two (Pookhao 2013).

The anthropocentric perspective towards ecotourism focuses on the sociocultural, economic, and community-based benefits and costs. As such, the global expansion of the environmental movement can be considered a perpetuation of this anthropocentric perspective due to economic benefits and resultant commercial or industrial development (Pookhao 2013), but also demonstrates ecocentrism by increasing consideration of intrinsic value in nature. Anthropocentrism is heavily embedded in the practice of ecotourism because it requires human-led management (Pookhao 2013). For example, wildlife tourism focused on marine megafauna (e.g. sharks) often relies upon “provisioning,” in which attractants, often food-based items such as chum or bait, are used to amass target species to provide consistent close-up encounters for tourists (Richards et al. 2015, Meyer et al. 2020). This simple act for human enjoyment can have impacts on both target and non-target marine species (Meyer et al. 2020), such as lower evolutionary fitness and increased

susceptibility to parasites in Southern Stingrays (*Dasyatis americana*), heightened competition, and behavioral changes that may influence an apex predator's ecological functioning (Hammerschlag et al. 2012). From personal experience snorkeling off the island of Ambergris Caye, Belize, the Caribbean Nurse Sharks at Shark-Ray Alley near Hol Chan Marine Reserve, would surround the boat and snorkelers immediately upon anchoring because of chum thrown into the water in canisters. According to our local guides, Shark-Ray Alley used to be a site where fishermen would come clean their gear in the water and others now chum the waters for tourists; as such, the sharks in the area have grown used to these practices.

Rather than practicing provisioning to attract marine megafauna for human enjoyment, potentially causing negative ecosystem-wide or individual impacts on species, marine ecotourists should visit areas where these organisms are likely to be found naturally, without human-initiated attraction or intervention. On the other hand, this may also have some negative effects on the organisms by having to acclimate to the presence of humans in their habitat. Those who participate in marine nature tourism, whether deep or shallow ecotourism, should aim to reduce their impact as much as possible. Any negative impact on local ecosystems can diminish the value and availability of future ecotourism opportunities. This would help unite anthropocentric ideals with ecocentric ideals in this industry, extending them beyond consideration of only human benefit. For example, in developing and implementing better ecotourism policies, China has begun focusing on enhancing education and promotion of environmentally friendly ecotourism, emphasizing the preservation of the natural environment, viewing the industry's development as a

scientific process, coordinating governmental organizations, and establishing financial support for areas developing ecotourism that may not have the financial means to support that development (Wang et al. 2009). Another suggestion to balance these two ethics could be to provide subsidies or grants for nature tourism companies that practice and promote environmental sustainability and actively attempt to mitigate their impact on the environment.

Some argue that ecotourism needs to integrate the scientific, cultural, and sociopolitical factors in order to achieve sustainable practices (Xu et al. 2014), but it needs more than that. The traditional model for ecotourism and environmental management follows modern western values that perpetuate the human-nature dichotomy (Xu et al. 2014), but we need to work towards erasing this separation of humans from the rest of nature. This can best be summarized by Dr. Carl Safina (2008) when he stated:

We need new policies. But policies reflect our values. So what we really need is a new ethic. It will have to be an ethic that considers the long term, not just the present. There is no real tradeoff between the economy and conservation. The tradeoff is always between short-term and long-term thinking. Today versus tomorrow.

In order to promote marine conservation, environmental education, sustainability, and respect for nature with the help of ecotourism, we need to consider our ethical values, the economy, and science in conjunction with one another. It is the connectedness of humans and our environment that is important as we rely upon and benefit each other in myriad ways. Ecotourism itself promotes an increased appreciation of the intrinsic and ecocentric values of nature, as opposed to only instrumental values. Ecotourism needs a

holistic balance between our modern anthropocentric perspective and the ecocentric view that humans and nature are a unified entity, thus valuing the sustainability and continuation of ecosystems and their organisms.

Chapter 5: What Ought We to Do?

“The sea, the great unifier, is man's only hope. Now, as never before, the old phrase has a literal meaning: we are all in the same boat.” – Jacques Yves Cousteau

In relation to environmental ethics, shark conservation, and the Tragedy of the Commons, an important question we must ask ourselves and others is this: What ought we to do? Additionally, how can we achieve balance with and respect for nature? Shark conservation is important, but what are some common practices? How can we mitigate the “Tragedy?” The first step to answering these questions requires us to evaluate our place among nature and inspect our own environmental ethical perspectives. Furthermore, learning about current conservation practices and other options to help mitigate the Tragedy of the Commons in our oceans will help us to recognize the myriad ways that humans are connected to nature, as well as how we influence and rely upon each other.

Evaluating Our Place in the Natural World

In order to change our perspectives of the environment and how we interact with our ecosystems, we must evaluate our place in the natural world and remember that human beings are as much a part of nature as the plants, animals, fungi, and other organisms that surround us. Each organism, including the average citizen, is a “cog in an ecological mechanism” and will benefit mentally and materially by working with that mechanism (Leopold 1949, 210) because human flourishing is situated within nature (Jordan & Kristjánsson 2017). In “A Sand County Almanac,” Aldo Leopold reminds us that “we shall

never [fully] achieve harmony with land [or sea], any more than we shall achieve absolute justice or liberty for people. In these higher aspirations the important thing is not to achieve, but to strive” (1949, 210). The corresponding issue, then, is how to strive for harmony with land and sea among “a people many of whom have forgotten there [are] such [things] as land [and sea], among whom education and culture have become almost synonymous with landlessness” (Leopold 1949, 210). Much of the primary education in our current society teaches us about the environment as if we are separate from it instead of teaching us that we are members of the Earth’s various ecosystems. We must strive to work with the oceans and lands around us rather than against them, and environmental education should strive to teach about respect and preservation of ecosystems and their organisms through a more ecocentric perspective, demonstrating that ecosystems have intrinsic, instrumental, and sustainable values.

To do this, we must change the role of *Homo sapiens* from a conqueror of land and ocean-communities to being a member and citizen of them, developing respect for fellow members and ecosystems (Leopold 1949). This can be done by incorporating Leopold’s Land Ethic and Safina’s Sea Ethic to develop the virtue of living in harmony with nature such that it “directly concerns the human-nature relationship,” but “also aims to foster a ‘new way of seeing the world and thinking’” in a way that is holistic, connective, and systemic (Jordan & Kristjánsson 2017). This is easier said than done, though, as we cannot will society to change its perspective overnight or simply add on to existing values; this would be better achieved by educating today’s youth (Jordan & Kristjánsson 2017). The adoption of a new environmental ethic must be habituated and cultivated as a unique virtue

“beginning in childhood and continued through self-improvement” (Hursthouse 2007, 164) as teaching a child to appreciate, care for, understand, and feel wonder for nature shapes a specific mindset that relates to the natural world (Hursthouse 2007, cited in Jordan & Kristjánsson 2017). Once we strive towards teaching our youth to develop a land-and-sea ethic, we will create a butterfly effect towards a better, more environmentally supportive future and further from a primarily homocentric world. More and more, people will want to experience nature, further enhancing their appreciation and respect for it.

Achieving balance or harmony with nature is paramount when it comes to science, environmental problems, and economic issues as they are all reliant upon each other to function sufficiently. Balancing anthropocentric and ecocentric ideals and abolishing the human-nature dichotomy will benefit not just the plants, fungi, non-human animals, and other organisms, but it will benefit nature as a whole, as well as the economy. Ivanhoe (1997) proposed that feeling one with nature, particularly believing that one is a part of the Earth’s larger ecosystem, helps humans avoid damaging and irrational behaviors, such as ecosystem degradation, and can offer satisfying and aesthetic feelings as well. If we can work with nature rather than against it, we create the potential to save our lands and oceans, to mitigate the Tragedy of the Commons, and work towards a more sustainable future.

Once we begin to shift our perspectives away from being separate from nature to being a part of nature, it will become much easier to respect the natural world and mitigate the harmful effects we have created over the years. Some ways that we can evaluate our place in nature include learning about our local ecosystems and how we affect each other when we interact, participating in or supporting sustainable environmental practices,

experiencing nature such as through ecotourism, collecting garbage from the beach or a local park, and teaching others the importance of preserving and respecting nature. One can also support local or regional environmental conservation efforts by participating in citizen science projects, making donations, or simply by raising awareness for conservation and its importance.

Current Conservation Practices and Suggestions

Marine and environmental conservation are excellent ways to further develop respect for the natural world and actively help to avoid the Tragedy of the Commons and other negative environmental impacts. As such, there is a wide variety of policies and programs for shark and general marine conservation. When getting involved in marine conservation, it is important to learn some of the different options that exist for protecting these animals and their habitats. For example, Shiffman & Hammerschlag (2015) note that there are two main forms of shark conservation policies: target-based policies and limit-based policies. Target-based policies are the most commonly implemented policy type for shark conservation and management. These policies allow for sustainable fisheries harvest of specific shark species, such as the Spiny Dogfish (*Squalus acanthias*), often through harvest quotas. Target-based policies also include strict bans on taking specific threatened species, gear restrictions, and year-round or time-restricted area closures (Shiffman & Hammerschlag 2015). On the other hand, limit-based policies ban some types of fisheries harvest with no species-specific focus, such as general shark-fin bans, shark sanctuaries, or no-take marine reserves: marine protected areas (MPAs) where the harvest of natural resources is prohibited (Shiffman & Hammerschlag 2015). MPAs are essential for

reversing the degradation and loss of ocean life and biodiversity, and marine reserves with stronger protection are more effective in preserving and restoring biodiversity, as well as increasing ecosystem resilience (Sala & Giakoumi 2017).

Not only are MPAs beneficial for marine habitat conservation, but they are also widely used for fisheries management, and are advocated as an option for protecting and restoring shark and ray populations (MacKeracher, Diedrich & Simpfendorfer 2018). Despite increasing support for MPAs as a tool for pelagic conservation, there have been many criticisms of the logistical, ecological, and economic feasibility in the pelagic ocean due to the prevalence of highly migratory species and the fact that much of the pelagic ocean is in the High Seas (Game et al. 2009). Due to the pelagic ocean including waters both within and outside areas of national jurisdiction, governance is complicated and there are fewer regulations focusing on conserving biodiversity compared to other areas (Game et al. 2009). MPAs in the pelagic zone face biological, design, governance, and enforcement challenges, but Game et al. (2009) suggest that each of these challenges can be overcome to successfully implement pelagic marine protected areas. Some of their suggestions include encompassing critical habitat or areas that will minimize location-specific threats, developing mobile fisheries closures for dynamic MPAs, further research, international and regional agreements for regulation, and improved remote surveillance via satellite Vessel Monitoring Systems (VMS) data (Game et al. 2009).

While pelagic MPAs and no-take marine reserves may be helpful for shark and marine habitat conservation, they are not the only options. Pew Research Center claimed in a 2012 report on current measures and gaps in global shark conservation that the three

primary tools for global shark conservation and management include the Convention on International Trade in Endangered Species (CITES), the Convention on Migratory Species of Wild Animals (CMS), and the International Plan of Action for Sharks (IPOA-Sharks). IPOA-Sharks aims to “ensure the conservation and management of sharks and their long-term sustainable use,” and “applies to States in the waters of which sharks are caught by their own or foreign vessels and to States the vessels of which catch sharks on the high seas” (FAO 2020, “International Plan of Action...”). Globally, these three main international efforts help conserve and manage shark species that are overfished, legally endangered, and/or vulnerable to extinction.

In other cases, regional fisheries management organizations (RFMOs) play critical roles in regulating fishing for highly migratory species to ensure the sustainability of relevant fisheries (Pew Research Center 2012). Additionally, some countries have passed laws or developed regulations prohibiting all commercial shark fishing throughout their EEZs, creating shark sanctuaries. Others have banned the sale, trade, and possession of shark parts, established gear restrictions, prohibited finning and retention of vulnerable species, and established catch quotas (Pew Research Center 2012).

Some of these policy tools are favored over others, such as target-based versus limit-based policies (Shiffman & Hammerschlag 2015). In terms of target-based policies, marine scientists showed high support for strict bans on taking specific threatened species and for catch quotas, but also criticized fisheries quotas by noting that they are not always effective as they are not always based on accurate scientific data, such as population size and life history (Shiffman & Hammerschlag 2015). Countries that have significant

financial and political resources have a larger variety of conservation and management options than developing countries; as such, they can establish gear restrictions, ban finning and the sale, trade, or possession of fins, and develop regulations on fishing the most vulnerable species while encouraging sustainable fishing practices.

It is also important to note that while some countries have more financial resources than others, those that have fewer resources or are still developing may not be able to implement specific policies, even those that are preferred by researchers and conservationists. This can make species-specific regulation difficult, especially in areas where fisheries are poorly documented and landed species of sharks or rays are only broadly identified (Bornatowski, Braga & Vitule 2014). For example, in Brazil there are many artisanal fishing communities far from large cities and industrial fishing harbors along the country's coast; the variety of fishing gear and resistance of fishermen to provide catch or biological data make effective management and monitoring of shark species much more difficult (Bornatowski, Braga & Vitule 2014). While it may be easier for developing countries or areas with large numbers of artisanal fisheries, like Brazil, to focus on establishing gear restrictions, limiting the number of fishing vessels, prohibiting finning, and establishing catch quotas, fishery control can still be difficult without the use of effective monitoring such as trained onboard observers or monitoring elasmobranch landings in main harbors (Bornatowski, Braga & Vitule 2014).

Other options in areas where financial support for conservation and management is limited include creating alternative livelihoods centered around supporting shark conservation, such as ecological tourism, or joining regional or international conservation

organizations to gather support for marine protection and monitoring efforts. Kraska & Gaskins (2015) note lines of action for helping sharks including determining ways to reduce direct and indirect catch (i.e. fishing and bycatch, respectively), increasing research on shark ecology, formulating recovery plans for those vulnerable to extinction, and monitoring shark populations over time. More importantly, part of the solution for conservation issues concerning elasmobranchs includes ensuring that research and science-based ideas are not restricted to the scientific community (Bornatowski, Braga & Vitule 2014) and establishing respect and appreciation for sharks and their importance (Kraska & Gaskins 2015). This will provide whole-community support and increase pressure on decision-makers, making it easier to implement conservation measures (Bornatowski, Braga & Vitule 2014).

Other Options to Mitigate the “Tragedy”

Outside of the conservation of vulnerable shark species and achieving human-nature holism, there are other options we can employ to prevent and/or mitigate the Tragedy of the Commons. For instance, sustainable ecotourism, furthering shark research, and incorporating an ecocentric perspective into K-12 environmental education will help raise awareness about the importance of sharks, their ecosystems, and the environmental issues surrounding them. Citizen science projects will help promote public engagement in marine research and conservation efforts, providing beneficial experiences that can increase appreciation of nature.

Another option to consider is the use of nature documentaries to increase public awareness, knowledge, and interest in marine ecosystems and their value. Some examples

of marine nature documentaries include the BBC's *Our Planet* and *Planet Earth* series, as well as Discovery Channel's *Shark Week*, although there are issues with *Shark Week* that would need to be addressed in relation to this. Dr. David Shiffman, a marine conservation biologist at the University of Miami, noted in an article that *Shark Week*'s longevity has given it a major role in the public understanding of shark science, but that "its legacy is a mixed bag" (2018, "Shark scientists explain..."). In this he noted some pros and cons, essentially arguing that *Shark Week* helps increase awareness for and interest in sharks, but is executed somewhat poorly. For example, *Shark Week* "elevates science and has inspired the next generation of marine biologists," myself included, but (sometimes deliberately) "gets the science wrong" (Shiffman 2018). *Shark Week* also includes a 30-second conservation PSA in its shows and often discusses threats to sharks and ways to protect them, helping highlight the importance of conserving elasmobranchs, but their messages "rarely focus on concrete solutions that viewers can promote" by suggesting conservation tips based on activities few viewers are likely to see, such as reporting illegal shark fishing (Shiffman 2018). While *Shark Week* has helped to promote research and interest in sharks, we need a series of elasmobranch-related nature documentaries that are more focused on their conservation, with helpful information that can effectively engage the public, and accurate science on the screen.

Other forms of education to increase awareness of marine environmental issues and public engagement in shark conservation include developing educational programs for local fishermen on the importance of overfishing, conservation, sustainable practices, and ecotourism. This may allow for some communities to create alternative livelihoods for

fishermen that are dependent on the continuance and sustainability of marine ecosystems and their organisms through non-extractive use (e.g. ecotourism). Other ways to help protect the continuance of marine ecosystems include implementing more pelagic marine protected areas (Game et al. 2009, Safina 2008) or shark sanctuaries in areas where shark harvest can be prohibited.

One of the most important options to help mitigate the Tragedy, originating in the economic structure of the fishing industry, includes fishery reform. For example, Safina (2008) argues that “we must replace the traditional fishery-management paradigm focused on taking with one focused on recovery,” zero-out subsidies that have “long encouraged overfishing and building along the coast,” allow scientists rather than fishing companies and governments to set catch quotas, and globally develop a framework of law for the open ocean (High Seas). If we can establish numerous reserves where sharks and their ecosystems can recover their numbers and productivity, we can help improve the biodiversity, functioning, and resilience of marine environments. Furthermore, fixing issues related to the Tragedy of the Commons will require stricter management of fishing (Safina 2008), such as through new policies and regulations. Kraska & Gaskins (2015) suggest that the Tragedy can be overcome by developing fishing regulations that can change seasonally to mitigate incidental catch. For example, Basking Sharks are often caught by trammel and trawl nets for cod and salmon due to their habit of “basking” near the surface of the water in the summer and spring, descending towards the continental shelf in the winter. As such, reducing the use of trawl nets in the winter and trammel nets in the

spring and summer may help reduce bycatch of certain shark species (Kraska & Gaskins 2015).

Finally, in attempting to mitigate the Tragedy, it is important to consider developing international monitoring programs for incidental catches of sharks, finning, and illegal catches. Effective shark conservation and management must be global (Pew Research Center 2012). We need to work together to develop and implement successful shark conservation and fisheries management programs in order to resolve the negative impacts we have brought upon the natural world because it is not just one country's responsibility. We have all played a part in the degradation of the natural world in one way or another, and it is up to us to fix it because we are not separate from nature; in fact, we need nature.

Conclusion

How we deal with environmental concerns seems to rely on our views of human-nature relationships. Human-nature dualism and anthropocentric values have long been present in a variety of cultural and philosophical viewpoints and appear to be reflected in the existing frameworks of corporate environmentalism and our theory of environmental management. While fundamentally selfish, this human-focused worldview has some positive aspects that have helped promote research and knowledge of the natural world. On the other hand, anthropocentrism has hindered the growth of environmental values that are not based on human gain and ignores many essential aspects of our relationship with nature. As such, we need to consider combining environmentally-oriented views with anthropocentrism and moving towards a more holistic, balanced view that is less focused on how the earth will benefit us and incorporates the intrinsic value of natural systems.

Aldo Leopold's *Land Ethic* (1949) and Carl Safina's *Sea Ethic* (2003) will be useful in this transition towards a more holistic environmental perspective by acknowledging the importance of both land and sea and their continued existence on Earth. Moreover, we will begin to see ourselves as citizens of nature rather than separate from it.

Economics is an important component of environmental ethics, research, policy, and our relationship with nature. Everything we do to protect marine environments and their species, such as sharks, must take this into account, and we must note that people have an economic interest in protecting these resources. The world's oceans are important common property systems, as the ocean and its resources cannot be controlled by any individual. The resources created by the sea are relatively available for harvest by anyone; thus, they are vulnerable to overexploitation and the Tragedy of the Commons.

The open ocean is sometimes ignored when it comes to marine conservation due to difficulties in maintaining the security of these areas from lack of jurisdiction, but this does not make these areas and their organisms any less important than those within a nation's jurisdiction. Additionally, overfishing is a particularly serious problem in the High Seas, as there are few agencies or organizations in the open ocean working to deter harmful practices such as illegal, unreported, and unregulated fishing. Poorly managed fisheries bring numerous species of whales, fish, sharks, and other marine animals closer to extinction, and in an uncontrolled environment the Tragedy of the Commons is unavoidable. Fortunately, the Tragedy can still be resolved and alleviated. In our efforts to attenuate the Tragedy and preserve marine environments, it is important to note and

understand that our economic behavior affects the environments in which we live, and vice versa, because we are part of the ecological systems that surround us.

Because our society is dominated by an anthropocentric perspective, the value of sharks is often overlooked by the general public, and many people think that sharks do not have important roles in their ecosystems. Contrary to this belief, sharks are important members of their communities and the loss of shark populations may result in the failure of certain ecosystem services, such as maintaining equilibrium in their habitats, eliminating ill or poor individuals from prey populations, and controlling species distribution and diversity. Due to their slow development, long gestation, and small numbers of young, elasmobranchs are very vulnerable to overexploitation and have limited ability to recover from threats such as overfishing and habitat loss. Due to this, multiple shark species are threatened with extinction.

Millions of sharks are killed each year as a result of commercial fishing, finning, and bycatch from these industries, and although U.S. shark fishing is relatively sustainable, there are fewer restrictions outside the United States where capture is often unsustainable, as most shark species cannot reproduce rapidly enough to satisfy the demand for their harvest. The reputation of sharks as voracious apex predators raises the prestige of their capture and boosts their economic value, but also inspires appreciation and the need for protection and conservation because of their vulnerability. It is important to remember the value of sharks in nature and how their conservation can benefit humans and the Earth's greater biotic system.

Humans and the natural world are interconnected; they depend on each other much as science, ethics, and economics do. When engaging with marine life, we frequently draw on scientific knowledge and social values to establish relationships with nature that can form our future perspectives and connections. Nature-based tourism to experience and appreciate nature can provide multiple benefits to local people, the economy, the environment, and the tourists themselves by increasing our respect for the ecosystems that surround us. Marine ecotourism can bring in money that helps sustain local economies and conservation projects more holistically than fishing or finning. It also ensures the ecological survival of shark species, protects shark habitats, develops an understanding of the environment through realistic experiences, and creates livelihoods that rely on environmental health, including alternative livelihoods for local fishermen. Experiencing nature in this way has the potential to increase our understanding and reverence for the environment and to establish the sustainability of ecosystems and their species.

There is an ongoing dilemma that represents the tension between anthropocentric and ecocentric ideals in this field. Anthropocentrism places an instrumental value on objects, and ecotourism brings a non-extractive economic value to preserved habitats and the persistence of biodiversity. A balance between ecocentrism and anthropocentrism is required to understand the inherent value of nature, which sometimes requires us to encounter what is being valued. Ecotourism itself encourages a wider acceptance of a sea ethic, which can potentially have a broader influence on the industry and our environmental perspectives. In addition, sustainable ecotourism shows that the perpetuation of ecosystems and their species is important in order to continue providing significant human benefits,

such as those offered by ecotourism. Moreover, some contend that ecotourism needs to incorporate academic, cultural, and socio-political influences in order to achieve sustainable practices, but it also needs to erase the dichotomy between humans and the rest of nature.

Achieving equilibrium or unity with nature is of the utmost importance when it comes to science, the environment, and the economy since they all rely on each other to work adequately. Balancing anthropocentric and ecocentric values and abolishing the human-nature dichotomy would not only help plants, non-human animals, and humans, but will benefit nature and society as a whole. When we begin to change our views from being removed from nature to being part of nature, it will become much easier to value the natural environment and minimize the negative effects that we have generated over the years. As Dr. Carl Safina vehemently noted,

People who think of themselves as conservationists carry a concern for wildlife, wild lands, habitat quality, and sustainable extraction as part of the collective ethic, their sense of right and wrong. It is high time to take these kinds of ideas below high tide. (2003, 5)

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